EFFECT OF DEUTERIUM ION BOMBARDMENT ON OPTICAL PROPERTIES OF BERYLLIUM MIRRORS

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Beryllium is the main material for fabrication of a large number of mirrors used in Earth satellites. As a mirror material, beryllium has some advantage in comparison to many other metals, namely, its reflectance in the nearest UV (in the wavelength range 0.1-0.25μm) can reach ~60%, i.e., is higher than in the visible range [1]. In connection with the plan to use this material as a protector for the first wall of a fusion reactor [2], interest developed in utilizing beryllium for fabrication of the so called first mirrors (FM) as a part of the in-vessel components for making optical and laser measurements. Since they are the plasma facing components of plasma diagnostics, the FMs will be subjected to different kinds of radiation emanating from a thermonuclear plasma: neutrons, gammas, x-rays, UV, and charge exchange atoms (CXA). The long-term effect of simultaneous impact of all those factors on the mirror properties cannot be predicted and special investigations on this subject must be conducted. In addition, the redeposition of materials transported from components subjected to the strongest plasma impact (e.g., the limiter) on the FM surface can also be important.

In the present paper we describe and analyze results obtained when mirrors fabricated from different kinds of beryllium are long-term bombarded by ions of deuterium plasma of keV energy range. After a quite short time of exposure to ions of deuterium plasma, when the sputtering erosion can be neglected, the beryllium reflectance drops 5-8 %, depending on the wavelength of reflecting light (λ=250– 650 nm, normal incidence). <u>We suppose that this effect is explained</u> by the transformation of the BeO film into a $Be(OD)_2$ film due to bombardment of the mirror by deuterium ions as described in [3]. It was found by use of ellipsometry at λ=632.8nm that the extinction index of beryllium hydroxide film is not negligible in comparison to a BeO film investigated in [4].

The annealing of the mirror after deuterium ion bombardment at 300C during a period of about 1hour resulted in the decomposition of $Be(OD)_2$ on the surface of beryllium mirror and restoration of BeO film with practically full restoration of the initial mirror reflectance. The details of process of the transformation of oxide film into hydroxide film and back will be discussed in terms of the results obtained. The decomposition of the film at the low temperature of annealing suggests that the $Be(OD)_2$ may not have reached an equilibrium stoichiometry or structure.

With much longer increase of exposure time of Be mirrors to ions of deuterium plasma (more than one order of magnitude), modification of the mirror surface morphology was observed, indicating that practically all of the oxide-hydroxide film was sputtered away and the sputtering of the metal itself was in process. As a result of ion etching, the microrelief on the mirror surface increased, with a corresponding deterioration of reflectance. The dynamics of reflectance degradation and development of microrelief will be discussed in the paper.

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